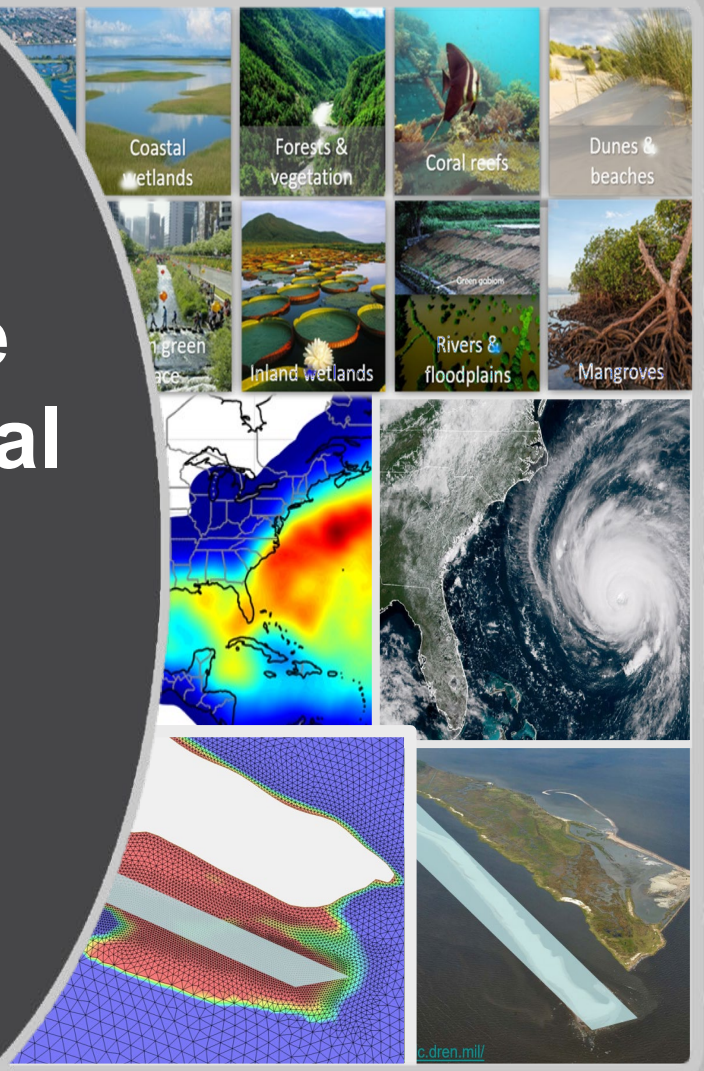
Engineering with Nature Toolkit for ERDC's Coastal Storm Modeling System



Amanda Tritinger, Chris Massey, Candice Piercy, Mary Bryant, and Fatima Bukhari

ADCIRC Users Group Meeting
March 30 - 31, 2020

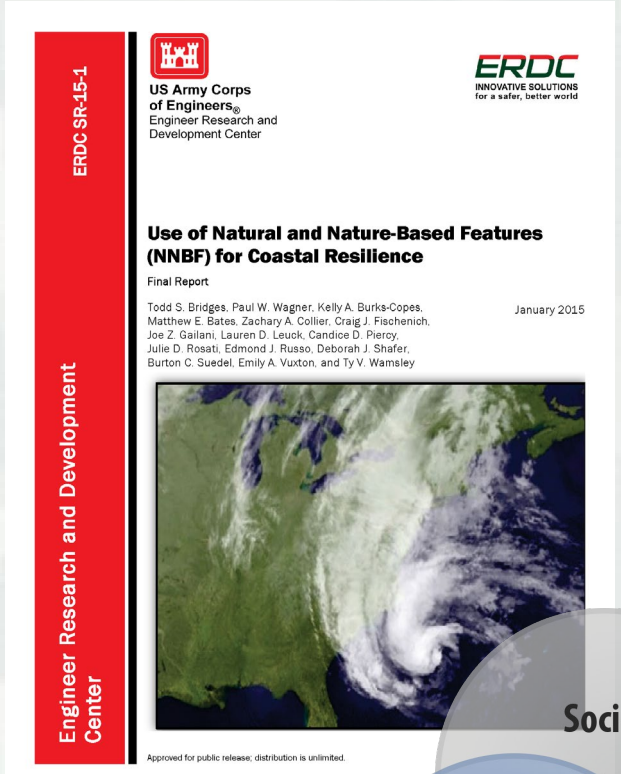
US Army Corps of Engineers

CSTORM-MS COASTAL STORM MODELING SYSTEM

EWN ENGINEERING WITH NATURE

ERDC ENGINEER RESEARCH & DEVELOPMENT CENTER

Engineering With Nature



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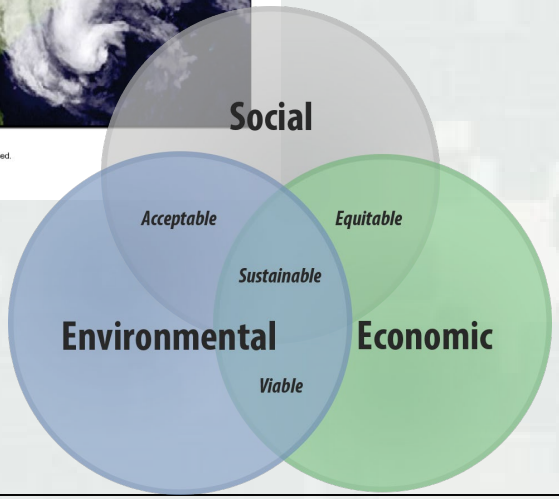
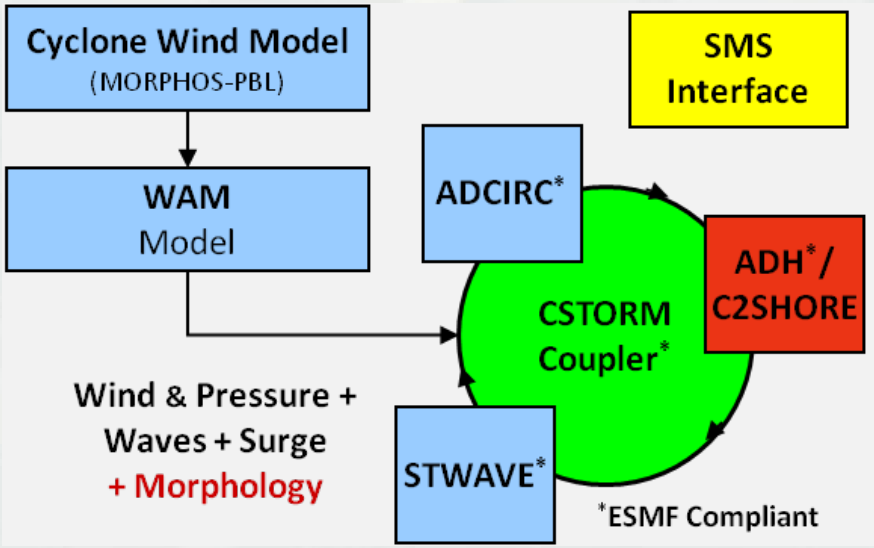


- Using science and engineering to produce operational efficiencies
- Using natural processes to maximize benefit
- Increasing the value provided by projects to include social, environmental, and economic benefits
- Using collaborative processes to organize, engage, and focus interests, stakeholders, and partners

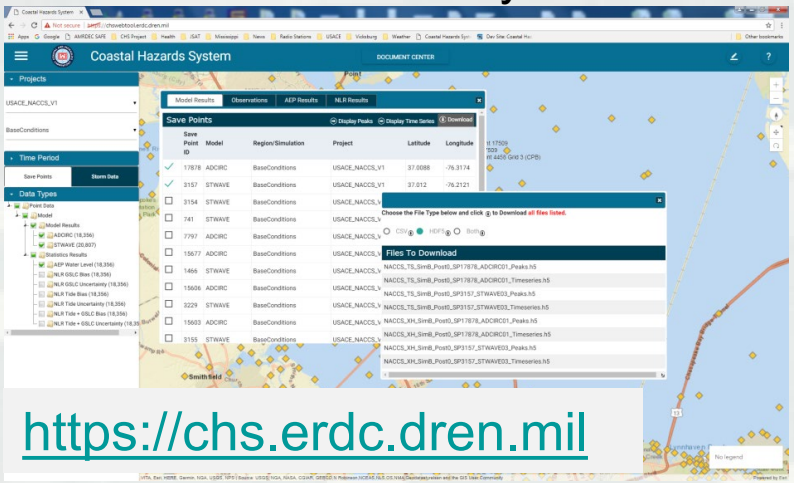
https://ewn.el.erdc.dren.mil

CSTORM-MS

- CSTORM-MS is an efficient, robust, extensible modeling system for quantifying the risk of coastal communities to storm events.
- Its' streamlined workflow saves time and reduces computational and personnel cost.
- Model data feeds into the Coastal Hazards System for easy access and reuse purposes.



Coastal Hazards System



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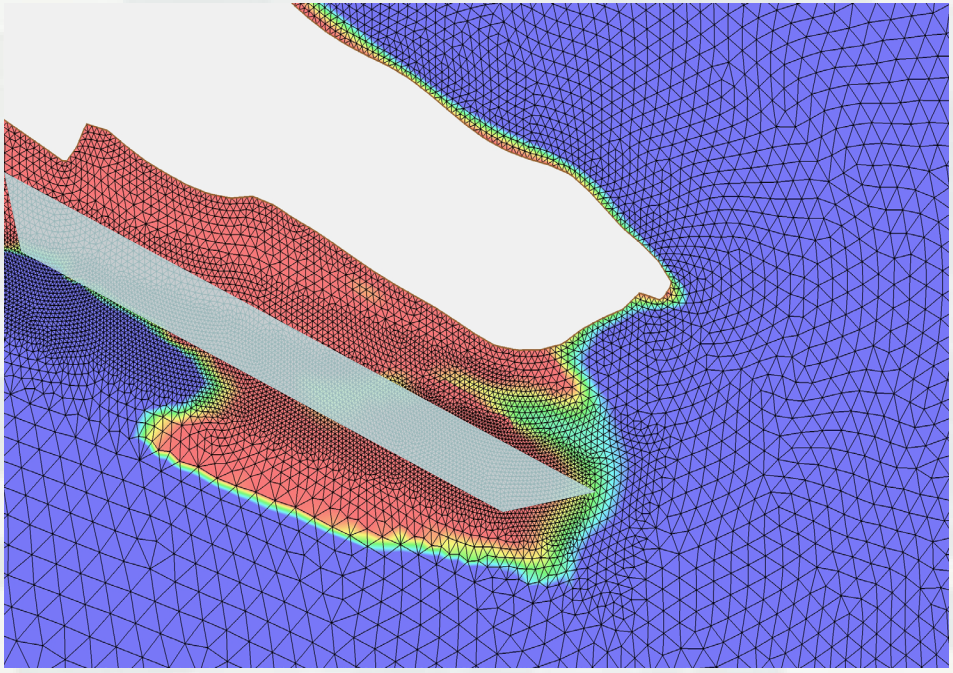
Technical Approach

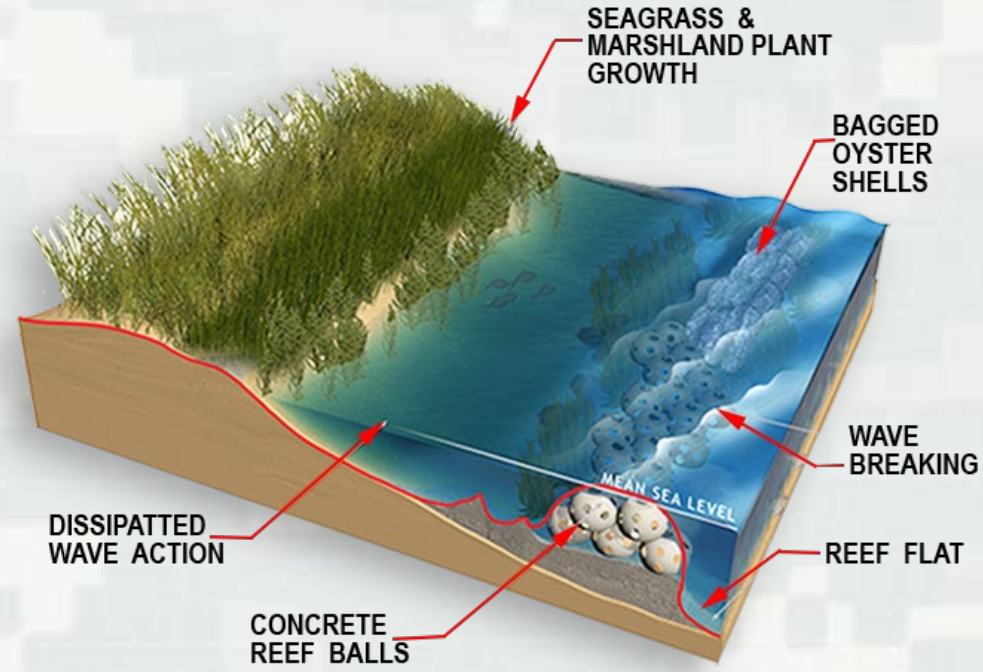
- Provide a GUI that allows rapid representation of EWN features in numerical models.
- EWN features will come with an options tab or drop down menu to adjust various parameters for that feature by the user.
- The SurfaceWater Modeling System (SMS) is the main GUI platform for model deployment, so it is the preferred deployment location for this toolkit.

Technical Approach



- The mesh/grid must have proper resolution to capture the feature location and the resulting hydrodynamic conditions.
- Semi-automatic model mesh/grid refinement will match a required spatial discretization of the EWN feature.
- Tools that perform similar remeshing tasks exist and can be configured and integrated in this workflow.

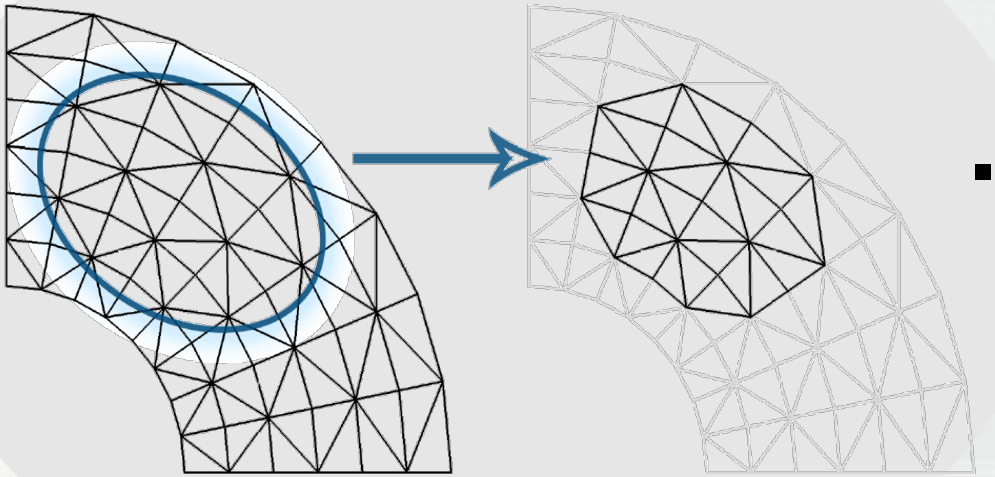
Technical Approach



https://ewn.el.erdc.dren.mil/nnbf.html

- EWN properties will be assigned as the polygons that represent those features are generated.
- The topographic and bathymetric changes will be assigned by the user and the Manning's n value will be available in a look up table.
- This will be based on existing literature studies or can be interactively selected by the user.

Innovative Approach



J. Baugh & his students at NC State University
https://adcirc.org/files/2015/04/sa-guide-15.pdf

- Sub-domain modeling will eventually be a used to keep computational demand low in the EWN toolkit.
- CSTORM-MS domains already exist and can be updated to include “with-project” features (NACCS, CTXCS, SACS, etc).
- This project will develop a set of metrics to be followed in order to offer a recommendation on sub-domain sizes for various “with-project” EWN features.

Example EWN Toolkit WORK FLOW

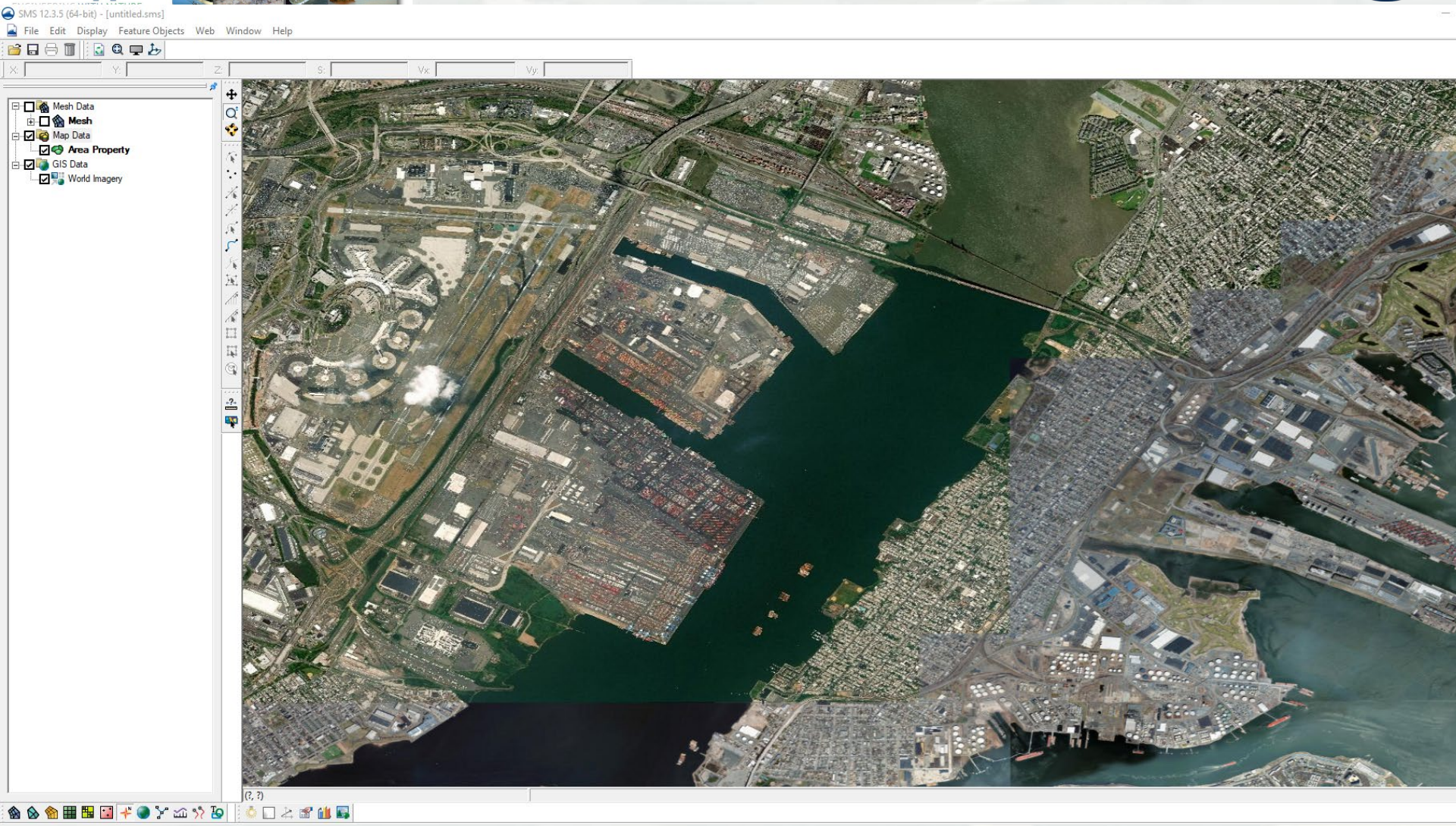
(not a working example)

CSTORM-MS

COASTAL STORM MODELING SYSTEM

EWN

COASTAL AND HYDRAULICS LABORATORY



CSTORM-MS

COASTAL STORM MODELING SYSTEM

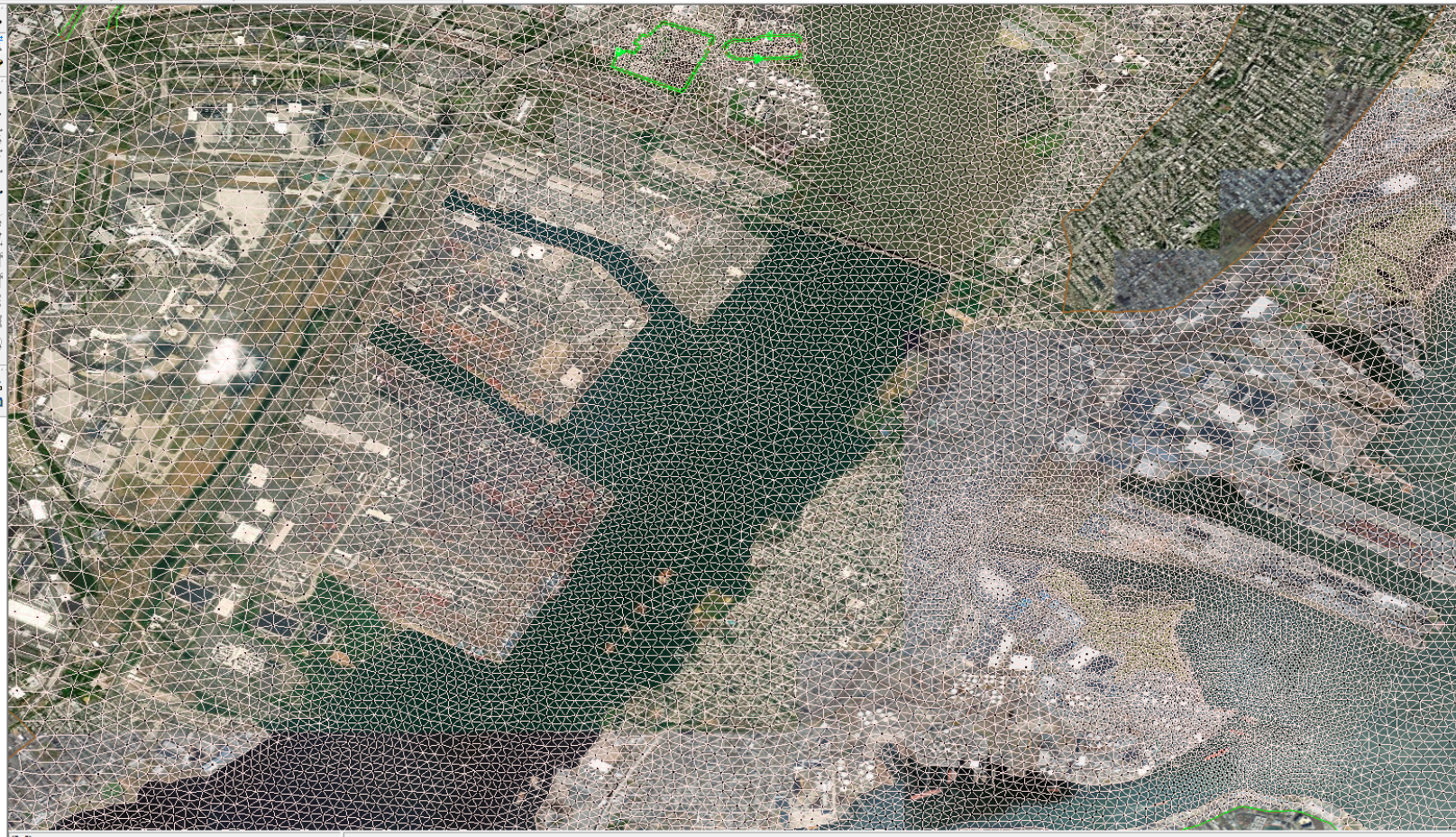
EWN

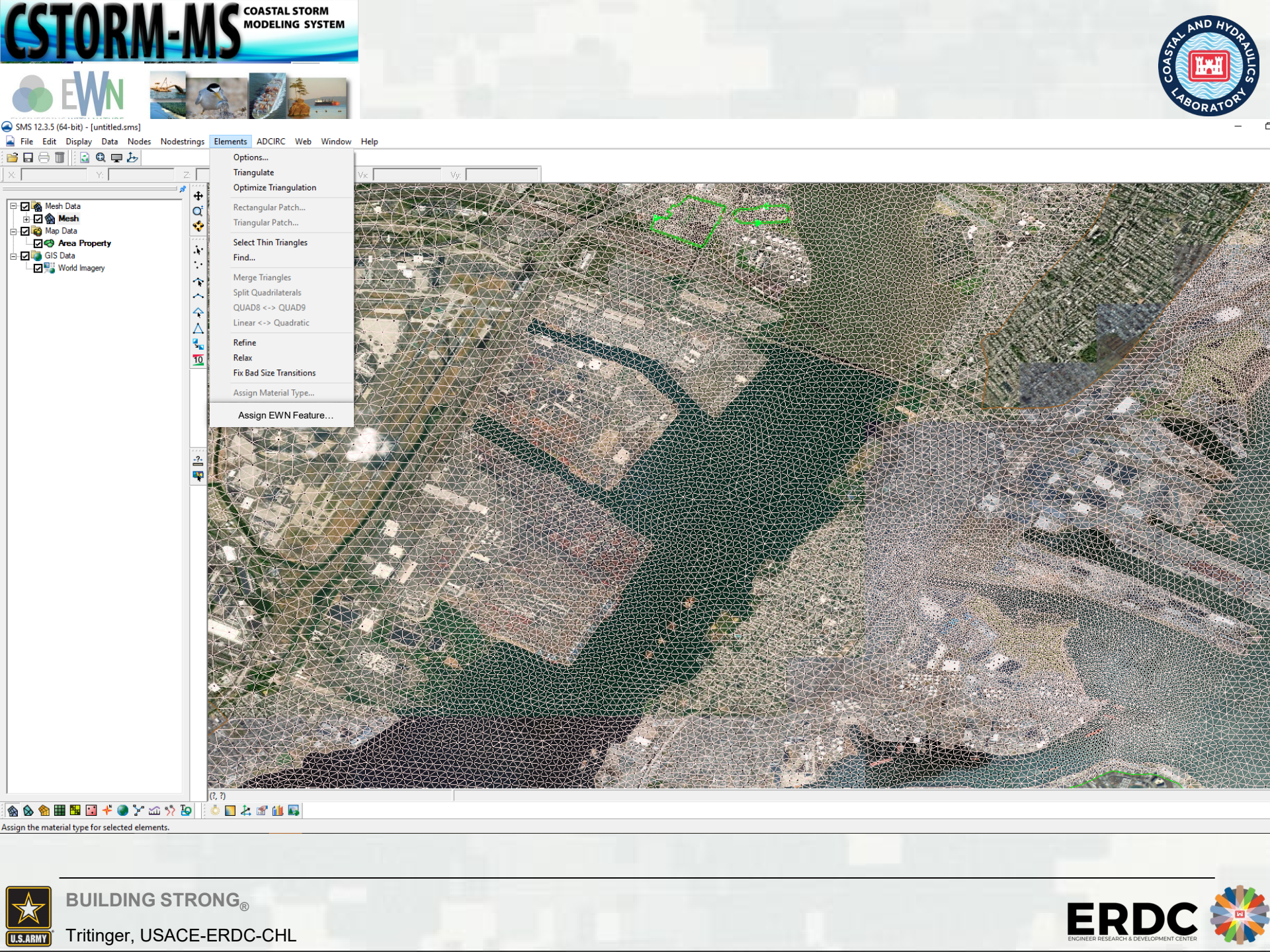
COASTAL AND HYDRAULICS LABORATORY

SMS 12.3.5 (64-bit) - [untitled.sms]

File Edit Display Feature Objects Web Window Help

- Mesh Data
  - Mesh
- Map Data
  - Area Property
- GIS Data
  - World Imagery




CSTORM-MS
COASTAL STORM MODELING SYSTEM
EWN
COASTAL AND HYDRAULICS LABORATORY
SMS 12.3.5 (64-bit) - [untitled.sms]
File Edit Display Data Nodes Nodestrings Elements ADCIRC Web Window Help
Options...
Triangulate
Optimize Triangulation
Rectangular Patch...
Triangular Patch...
Select Thin Triangles
Find...
Merge Triangles
Split Quadrilaterals
QUAD8 <-> QUAD9
Linear <-> Quadratic
Refine
Relax
Fix Bad Size Transitions
Assign Material Type...
Assign EWN Feature...
Mesh Data
Mesh
Map Data
Area Property
GIS Data
World Imagery
Assign the material type for selected elements.

SMS 12.3.5 (64-bit) - [untitled.sms]

File Edit Display Feature Objects Web Window Help

X: Y: Z: S: Vx: Vy:

- Mesh Data
  - Mesh
- Map Data
  - Area Property
- GIS Data
  - World Imagery

Assign EWN Feature

Select Feature: Marsh

Select Vegetation: Spartina alt.

Select Feature: Medium

Select Feature Height: 3 Feet

ok

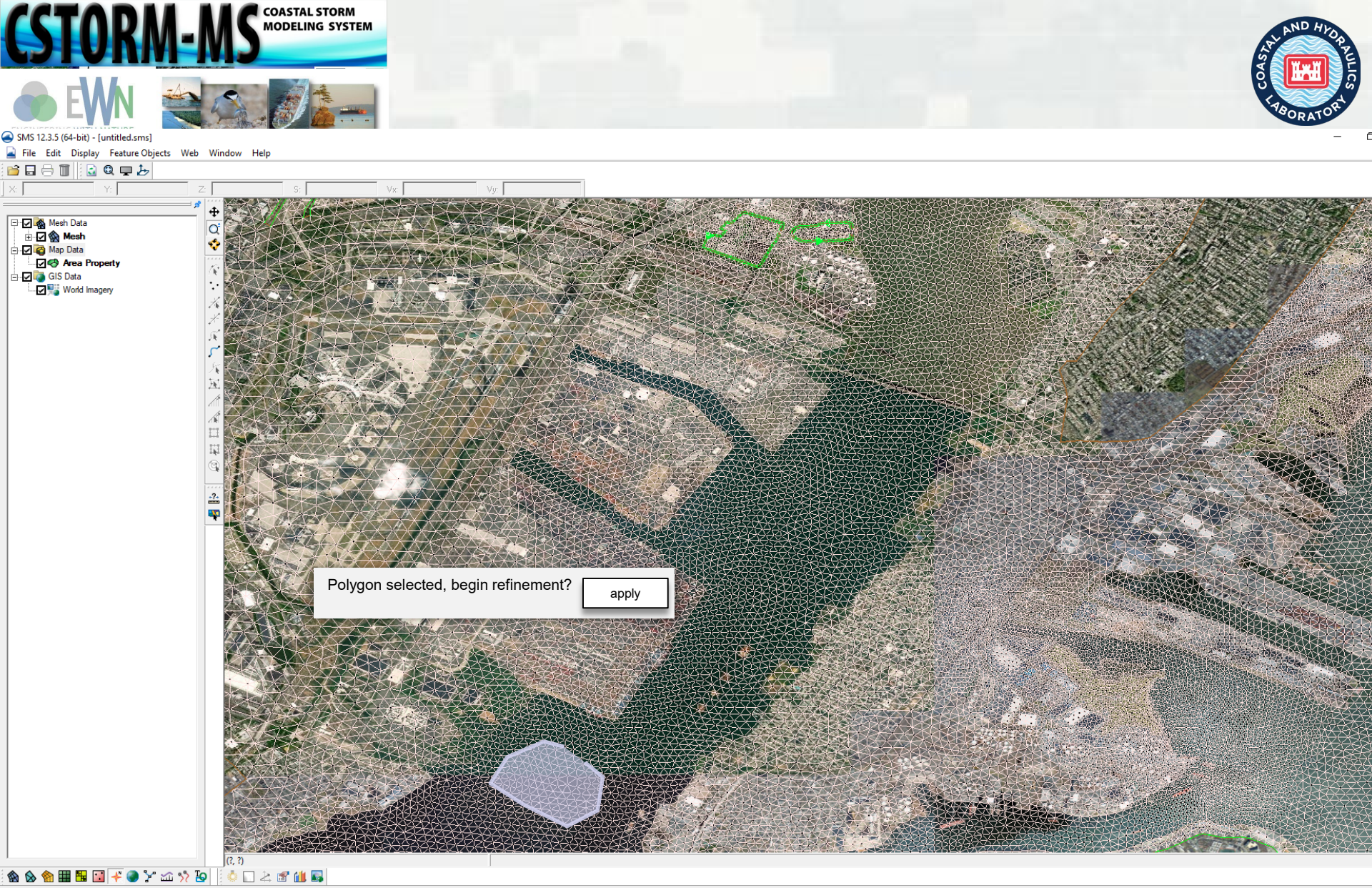
(?, ?)

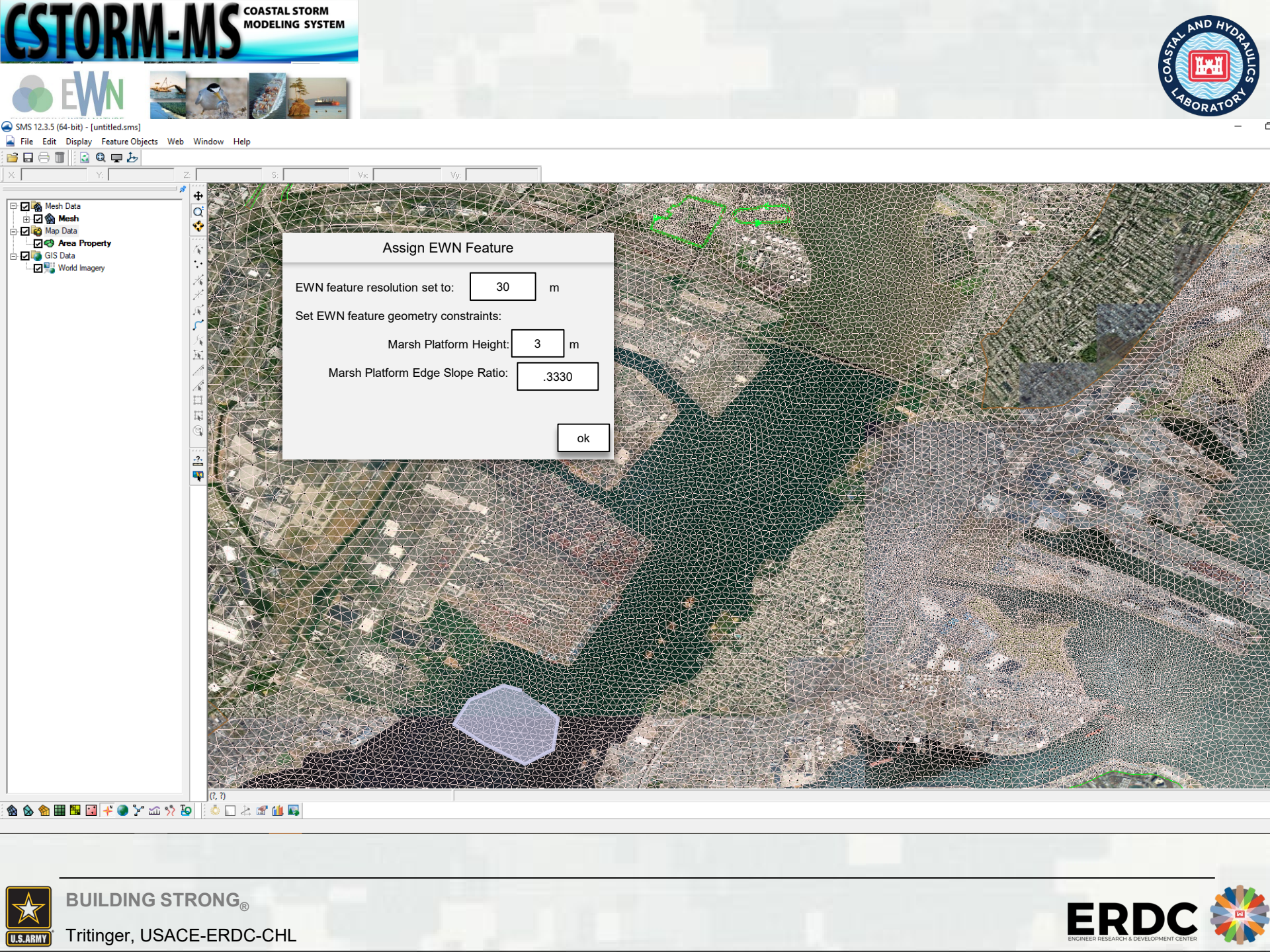
SMS 12.3.5 (64-bit) - [untitled.sms]

File Edit Display Feature Objects Web Window Help

Mesh Data
Mesh
Map Data
Area Property
GIS Data
World Imagery

Draw feature polygon...


CSTORM-MS
COASTAL STORM MODELING SYSTEM
EWN
COASTAL AND HYDRAULICS LABORATORY
SMS 12.3.5 (64-bit) - [untitled.sms]
File Edit Display Feature Objects Web Window Help
Mesh Data
Mesh
Map Data
Area Property
GIS Data
World Imagery
Polygon selected, begin refinement?
apply


CSTORM-MS
COASTAL STORM MODELING SYSTEM
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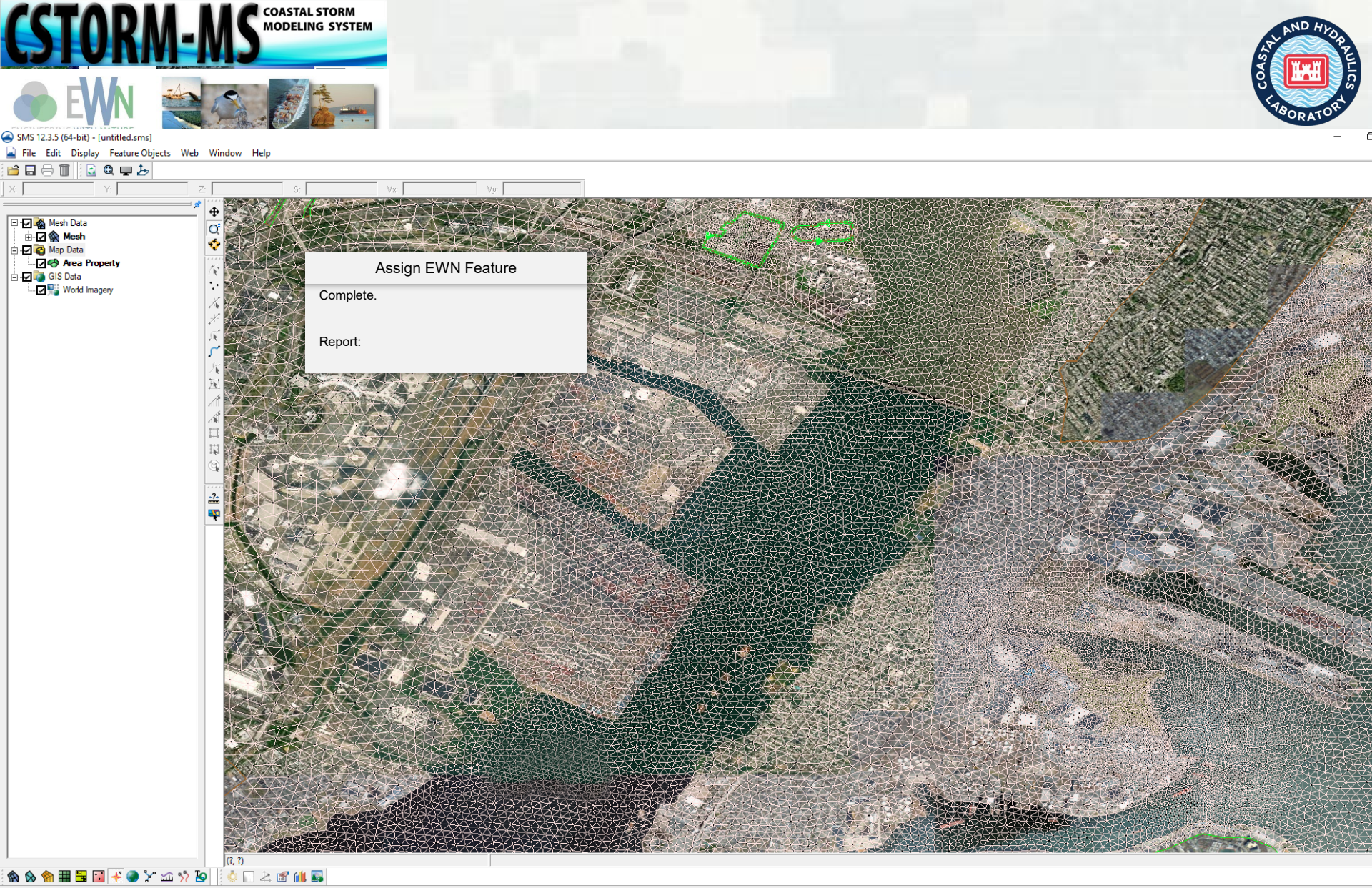
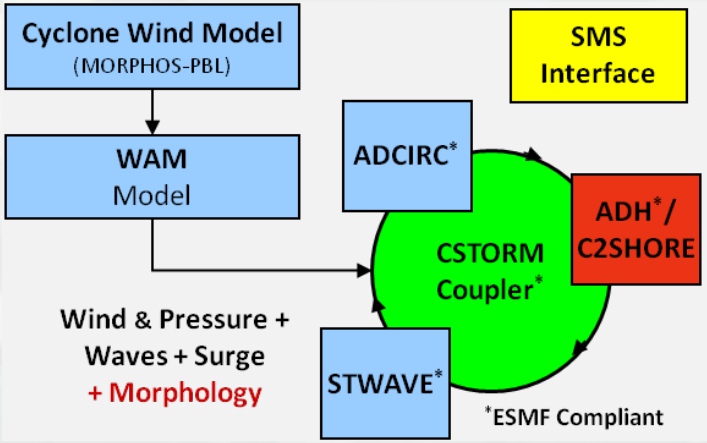
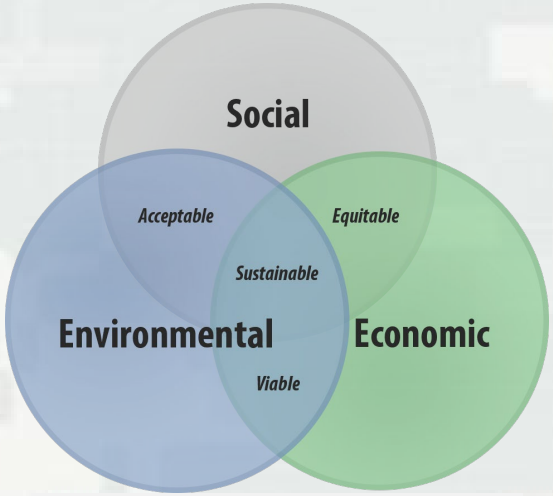
COASTAL AND HYDRAULICS LABORATORY
SMS 12.3.5 (64-bit) - [untitled.sms]
File Edit Display Feature Objects Web Window Help
Mesh Data
Mesh
Map Data
Area Property
GIS Data
World Imagery
Assign EWN Feature
EWN feature resolution set to: 30 m
Set EWN feature geometry constraints:
Marsh Platform Height: 3 m
Marsh Platform Edge Slope Ratio: .3330
ok


CSTORM-MS
COASTAL STORM MODELING SYSTEM
EWN
COASTAL AND HYDRAULICS LABORATORY
SMS 12.3.5 (64-bit) - [untitled.sms]
File Edit Display Feature Objects Web Window Help
Mesh Data
Mesh
Map Data
Area Property
GIS Data
World Imagery
Assign EWN Feature
Complete.
Report:

Summary

This toolkit will reduce computational and personnel resources associated with integrating EWN and NNBF features into hydrodynamic numerical modeling analysis, by allowing users the ability to automatically/semi-automatically add features through a standardized technique and allow them to quickly manipulate multiple aspects of their design.





https://ewn.el.erdc.dren.mil

Team Acknowledgements

- Chris Massey – (CSTORM Modeling Team Lead)
- Candice Piercy – (Engineering with Nature Lead)
- Mary Bryant – (Nearshore Waves Lead)
- Fatima Bukhari – (Sub-Domain Modeling Lead)
- Amanda Tritinger – (PI, Modeling Team Member)
- Alan Zundel – (SMS GUI Development Team)
- Alan Lemon – (SMS GUI Development Team)

Suggestions/Questions?

Contact Information

Amanda Tritinger, PhD

Engineering with Nature CSTORM Toolkit PI

U.S. Army Engineer R&D Center

Coastal and Hydraulics Laboratory

email: Amanda.S.Tritinger@erdc.dren.mil